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(f) means for applying voltages to said at least one multipole ion guide to direct said ions along a desired ion trajectory within said at least one multipole ion guide;

(g) means to pulse ions into said mass analyzer; and

(g) means for applying additional voltages which impart energy to said ions within said at least one multipole ion guide so as to cause fragmentation of said ions located within said multipole ion guide.

34. An apparatus according to claim 33, wherein said ion source produces ions at substantially atmospheric pressure.

35. An apparatus according to claim 33, wherein said ion source is an Electrospray ion source.

36. An apparatus according to claim 33, wherein said ion source is an atmospheric pressure chemical ionization source.

37. An apparatus according to claim 33, wherein said ion source is an Inductively Coupled Plasma ion source.

38. An apparatus according to claim 33, wherein said ion source is a glow discharge ion source.

39. An apparatus according to claim 33, wherein said at least one multipole ion guide begins and ends in one of said vacuum stages.

40. An apparatus according to claim 33, wherein said at least one multipole ion guide extends continuously into at least two of said vacuum stages.

41. An apparatus according to claim 33, wherein said at least one multipole ion guide is configured as a quadrupole.

42. An apparatus according to claim 33, wherein said at least one multipole ion guide is configured as a hexapole. ✓

43. An apparatus according to claim 33, wherein said at least one multipole ion guide is configured as an octapole. ✓

44. An apparatus according to claim 33, wherein said at least one multipole ion guide is configured with a number of said parallel poles greater than 8. ✓

45. An apparatus according to claim 33, further comprising a means for controlling electrical voltages applied to said poles of said at least one multipole ion guide, wherein said means for controlling said electrical voltages applied to said electrode elements can be set to trap ions in said at least one multipole ion guide. ✓

46. An apparatus according to claim 33, further comprising a means for controlling electrical voltages applied to said poles of said at least one multipole ion guide, and said means for controlling said electrical voltages applied to said electrode elements can be adjusted to cause fragmentation of said selected m/z values of said ions in said internal volume of said at least one multipole ion guide by Collision Induced Dissociation of said ions with neutral background molecules. ✓

47. An apparatus according to claim 46, wherein said Collisional Induced Dissociation of said selected m/z values of said ions is caused by resonant frequency excitation.

48. An apparatus according to claim 47, wherein said selected m/z values of said ions are trapped in said at least one multipole ion guide.

49. An apparatus according to claim 48, wherein said Collisional Induced Dissociation of said ions trapped in said at least one multipole ion guide is achieved by the steps of releasing ions from said exit end of said at least one multipole ion guide, increasing the energy of said ions

outside said internal volume of said multipole ion guide, accelerating said ions back into said exit end of said at least one multipole ion guide with said increased translational energy, wherein said accelerated ions collide with said neutral background molecules in said internal volume of said at least one multipole ion guide as said ions traverse a portion of said multipole ion guide length moving from said exit to said entrance end of said at least one multipole ion guide

50. An apparatus according to claim 49, wherein said Collisional Induced Dissociation of said ions trapped in said at least one multipole ion guide is achieved by filling said at least one multipole ion guide operated in said trapping mode with said ions until said fragmentation of a portion of said ions occurs.

51. An apparatus according to claim 33, wherein a portion of said internal volume of said at least one multipole ion guide has a pressure in the range of  $10^{-4}$  to  $10^{-2}$  torr.

52. An apparatus according to claim 33, wherein a portion of said internal volume of said at least one multipole ion guide has a pressure in the range of  $10^{-4}$  to  $10^{-1}$  torr.

53. An apparatus according to claim 51, further comprising a means for controlling electrical voltages applied to said poles of said at least one multipole ion guide, and said means for controlling said electrical voltages applied to said electrode elements can be adjusted to select the range of m/z values of said ions transmitted through or trapped in said at least one said multipole ion guide.

54. An apparatus according to claim 33, wherein said mass analysis means can acquire mass spectra of a portion of the population of ions which exit said at least one multipole ion guide operated in non fragmentation mode followed by acquisition of mass spectra of a portion of the population of ions which exit said at least one multipole ion guide operated in said selected m/z range ion fragmentation mode whereby the mass spectra of said unfragmented ions

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is subtracted from the mass spectra of selected said fragmented ions producing a mass spectra containing peaks of only fragment ions and the ions which were fragmented, said resulting subtracted mass spectrum contains MS/MS analysis information.

55. An apparatus according to claim 33, wherein said mass analysis means can acquire mass spectra of a portion of the population of ions which exit said at least one multipole ion guide operated in non fragmentation mode followed by acquisition of mass spectra of a portion of the population of ions which exit said at least one multipole ion guide operated in said multiple selected m/z range ion fragmentation mode whereby the mass spectra of said unfragmented ions is subtracted from the mass spectra of selected said fragmented ions producing a mass spectra containing peaks of only fragment ions, fragments of fragment ions and the ions which form which the first fragmentation occurred, said resulting subtracted mass spectrum contains MS/MS<sup>n</sup> analysis information where n is an integer greater than zero.

56. An apparatus according to claim 33, further comprising means for controlling said electrical voltages applied to said poles of said at least one multipole ion guide, and said means for controlling said electrical voltages applied to said electrode elements can be adjusted during the data acquisition period such that a portion of said ions produced by said ion source continuously enter said at least one multipole ion guide.

57. A method of analyzing chemical species utilizing an ion source, a vacuum system with at least one vacuum pumping stage, at least one multipole ion guide located in at least one of said vacuum pumping stages, and a mass analyzer, said method comprising:

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- (a) producing ions from a sample substance using said ion source;
  - (b) directing said ions into said multipole ion guide;

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(c) fragmenting ions in said multipole ion guide to form an ion population in said multipole guide which contains fragment ions;

(d) pulsing said ion population which contains fragment ions toward said mass analyzer; and

(e) conducting mass to charge analysis of at least a portion of said ion population with said mass analyzer.

58. A method according to claim 57, wherein said ions are produced using Electrospray ionization.

59. A method according to claim 57, wherein said ions are produced using Atmospheric Pressure Chemical Ionization.

60. A method according to claim 57, wherein said ions are produced using Inductively Coupled Plasma Ionization.

61. A method according to claim 57, wherein said ions are fragmented in said at least one multipole ion guide using resonant frequency excitation collisional induced dissociation fragmentation of ions with the neutral background gas present in the volume of said multipole ion guide.

62. A method according to claim 57, wherein said ions are fragmented in said at least one multipole ion guides by acceleration of ions from one said multipole ion guide to a second said multipole ion guide causing collisional induced dissociation fragmentation of said ions due to collisions of said ions with neutral background gas present in the volume of said second multipole ion guide.

63. A method according to claim 57, wherein said ions are fragmented in said at least one multipole ion guide by accelerating said ions into said ion guide volume where said ions collide